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This investigation attempted to determine how pupil attitudes toward mathematics might be changed by introducing the new Laidlaw Series in the Moscow Elementary School during the academic year of 1965-66. The Kansas Arithmetic Inventory for Elementary Pupils was administered as a pretest prior to the introduction of the new text and a post-test after the new modern mathematics text had been used for seven months. The result of the experiment, assuming the validity of the arithmetic inventory instrument, showed that there is no statistical evidence that the introduction of this new textbook series had any real effect in developing more desirable pupil attitudes toward elementary school mathematics. (RP)

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# AN INVESTIGATION OF CHANGES IN PUPIL ATTITUDE TOWARDS MATHEMATICS AS A RESULT OF INTRODUCING A MODERN MATHEMATICS TEXT

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# AN INVESTIGATION OF CHANGES IN PUPIL ATTITUDE TOWARDS MATHEMATICS AS A RESULT OF INTRODUCING A MODERN MATHEMATICS TEXT

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The Moscow Elementary School was introducing the new Laidlaw Series in its elementary school during the academic year of 1965--1966 and Principal Kenneth Shields was interested in determining possible changes in pupil attitude as a result of the change from the older type of mathematics to the new emphasis in mathematics.[1]

It was decided to administer the Kansas Arithmetic Inventory for Elementary Pupils, as developed by this writer, in the fall of 1965 and in the spring of 1966. The theory was that possible pupil response changes during the year relating to attitude would be due to the introduction of the new arithmetic book.

Prior to the administration of this arithmetic inventory to pupils in the Moscow schools, the inventory was administered to pupils in other classes of other schools. Means and standard deviations were calculated on these other pupil scores and a correlation coefficient was calculated between each item and every other item on the inventory.

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[1] This investigator wishes to thank Principal Shields and the staff at Moscow, Kansas, for their cooperation on this project. This type of pupil evaluation frequently is considered by teachers in general as a personal evaluation and the Moscow staff is to be congratulated for their willing participation.

The Kansas Arithmetic Inventory for Elementary Pupils. This inventory was devised with five possible choices and an equal number of positive and negative responses to permit its application using such as the Lickert Scale for evaluation. The polarity of the items varies because a given positive, or negative, response could be a disagree or an agree type of response. Each item was constructed in terms of some type of rationale. The thirty items, starting with the teacher directions for the Kansas Arithmetic Inventory, is found in Appendix A. The polarity of each item is indicated to the left of the item.

Some Previous Research on the Inventory Items. The inventory was administered to the pupils of some teachers taking Education 518 during the spring of 1964. For each item, means and standard deviations were calculated and these are reported in Table I below.

TABLE I

MEANS AND STANDARD DEVIATIONS FOR EACH ITEM OF THE KANSAS ARITHMETIC INVENTORY USING A SAMPLE OF PUPILS AT EACH GRADE LEVEL (1-6) IN VARIOUS SCHOOLS

| ITEM (NUMBER) | MEANS | STANDARD DEVIATION |
|---|---|---|
| 01 | 3.7 | .16 |
| 02 | 2.1 | .22 |
| 03 | 3.7 | .16 |
| 04 | 3.4 | .31 |
| 05 | 3.3 | .28 |
| 06 | 2.1 | .27 |
| 07 | 3.4 | .22 |
| 08 | 3.0 | .47 |
| 09 | 2.6 | .31 |
| 10 | 4.1 | .24 |
| 11 | 2.8 | .41 |
| 12 | 4.1 | .17 |
| 13 | 3.7 | .42 |

TABLE I (Continued)

| ITEM NUMBER | MEANS | STANDARD DEVIATION |
|---|---|---|
| 14 | 3.3 | .26 |
| 15 | 3.4 | .26 |
| 16 | 2.8 | .32 |
| 17 | 4.1 | .16 |
| 18 | 2.9 | .43 |
| 19 | 3.6 | .29 |
| 20 | 3.5 | .30 |
| 21 | 2.6 | .39 |
| 22 | 2.7 | .44 |
| 23 | 4.5 | .11 |
| 24 | 2.8 | .47 |
| 25 | 2.5 | .50 |
| 26 | 3.6 | .49 |
| 27 | 3.5 | .42 |
| 28 | 3.8 | .36 |
| 29 | 2.4 | .36 |
| 30 | 2.3 | .41 |

In the above, 3.0 would be the theoretical mean, assuming the operation of choice factors alone, regardless of the polarity of a positive response. Some items vary from this more than do others. Considerable variation is also seen in the standard deviations. The greatest variation of scores from the means is found in items 8, 11, 13, 18, 22, 24, 25, 26, 27, and 30.

Considering the intercorrelations of items (see Appendix B) and adjusting for polarity, some items correlate positively with most others whereas some items show a high negative correlation. For example, items one and three correlate positively but both items correlate negatively with item two. Apparently, all the items are not measuring the same aspects of thinking in connection with mathematics and perhaps 30 different factors are involved. On the other hand item 15 correlated positively with every

other item except with item six and item two. Probably some items on the inventory could be eliminated for over-all effectiveness, but none of the intercorrelations is significant and more research is needed.

Results of the Moscow Evaluation. The results of the administration of the Kansas Arithmetic Inventory to pupils for the fall and spring are shown in Table II.

TABLE II

RESULTS OF THE TEST OF SIGNIFICANCE OF THE DIFFERENCE BETWEEN THE MEANS

| Grade Level | Number of Pupils | Fall Mean | Spring Mean | Differences Between Means (t-test) |
|---|---|---|---|---|
| II | 11 | 91.36 | 94.36 | .99 |
| III | 11 | 107.09 | 108.09 | .18 |
| IV | 9 | 102.22 | 93.33 | 1.54 |
| V | 10 | 98.00 | 97.80 | .03 |
| VI | 7 | 99.43 | 102.14 | .60 |

No mean differences given in Table II are large enough to be significant. Considering only the spring post-test, the mean differences using the t-test, are insignificant between grade levels except that the third grade mean score is significantly larger than those of the second grade as well as those of the fourth grade. The differences probably are due to the operation of causes other than chance but this study does not identify these causes. Nevertheless, it should be noted that frequently the arithmetic curricula become difficult, even frustrating, in the intermediate grades after a simple and easy primary grade program.

Assuming that this arithmetic inventory is valid, there is no evidence that the introduction of this new text-book, as used in this situation, had any real effect in developing more desirable pupil attitudes toward arithmetic. This text is not a great deal different than the older text and this may be the reason for the finding of no significant differences in attitudes. In general it would seem that what we are doing, at least in some mathematical programs, does not meet our hopes and expectations.

APPENDIX A

KANSAS ARITHMETIC INVENTORY FOR ELEMENTARY PUPILS.

Willard O. Stibal

Each of the following statements may be correct or right for some children and not correct for other children. Merely give your opinions as you feel about the statements. For example, if you completely agree with a statement or completely disagree, you would mark either 5 or 1. If you cannot decide, mark 3. If you agree with most of it, you mark 4; but if you do not like most of it, mark 2.

The teacher will read and explain at least the first item. Put a circle around the number that shows how you feel about the statement. If you do not understand a statement, raise your hand and the teacher will explain it.

(P) 1. Most pupils I know like arithmetic.
(1) Strongly disagree (2) Disagree (3) Undecided
(4) Agree (5) Strongly agree

(N) 2. Most teachers of arithmetic do not explain things as well as in other subject areas.
(1) Strongly disagree (2) Disagree (3) Undecided
(4) Agree (5) Strongly agree

(P) 3. After reading and studying the arithmetic problems, most members of our class can tell what operations (addition, subtraction, multiplication or division) to use.
(1) Strongly disagree (2) Disagree (3) Undecided
(4) Agree (5) Strongly agree

(P) 4. I do about as well in arithmetic as other pupils have done in these classes.
(1) Strongly disagree (2) Disagree (3) Undecided
(4) Agree (5) Strongly agree

(N) 5. Most of the pupils in our class do not need help from their parents in doing arithmetic homework.
(1) Strongly disagree (2) Disagree (3) Undecided
(4) Agree (5) Strongly agree

(N) 6. To most pupils I know, arithmetic just does not make sense.
(1) Strongly disagree (2) Disagree (3) Undecided
(4) Agree (5) Strongly agree

(P) 7. My friends feel that arithmetic has more value than most other subjects.
(1) Strongly disagree (2) Disagree (3) Undecided
(4) Agree (5) Strongly agree

(N) 8. Most of my classmates do not like the difficult assignments and hard homework that arithmetic requires.
(1) Strongly disagree (2) Disagree (3) Undecided
(4) Agree (5) Strongly agree

(N) 9. Most of my friends dislike doing the arithmetic examples that we do for practice in class.
(1) Strongly disagree (2) Disagree (3) Undecided
(4) Agree (5) Strongly agree

(P) 10. Arithmetic has many applications in work or thinking about other things such as cutting wood, measuring amounts, studying distances, buying things and the like.
(1) Strongly disagree (2) Disagree (3) Undecided
(4) Agree (5) Strongly agree

(N) 11. Most of my friends have always had trouble doing arithmetic.
(1) Strongly disagree (2) Disagree (3) Undecided
(4) Agree (5) Strongly agree

(P) 12. Many occupations depend upon arithmetic as a foundation.
(1) Strongly disagree (2) Disagree (3) Undecided
(4) Agree (5) Strongly agree

(P) 13. My friends feel that arithmetic is fun.
(1) Strongly disagree (2) Disagree (3) Undecided
(4) Agree (5) Strongly agree

(P) 14. The other pupils like arithmetic about as well as most other subjects.
(1) Strongly disagree (2) Disagree (3) Undecided
(4) Agree (5) Strongly agree

(N) 15. For most pupils, some parts of the arithmetic program are very difficult as compared with the other parts.
(1) Strongly disagree (2) Disagree (3) Undecided
(4) Agree (5) Strongly agree

(N) 16. Most of my friends do not understand why we do some things in arithmetic.
(1) Strongly disagree (2) Disagree (3) Undecided
(4) Agree (5) Strongly agree

(P) 17. Many of the things taught in arithmetic have practical value outside of school.
(1) Strongly disagree (2) Disagree (3) Undecided
(4) Agree (5) Strongly agree

(N) 18. Most pupils do better than I do in arithmetic.
(1) Strongly disagre (2) Disagree (3) Undecided
(4) Agree (5) Strongly agree

(P) 19. Most teachers of arithmetic know the material as well as the teachers in other subjects.
(1) Strongly disagree (2) Disagree (3) Undecided
(4) Agree (5) Strongly agree

(P) 20. Most members of our class have a good understanding of the mathematical relationships between addition, subtraction, multiplication and division or such as fractions, decimals and percentage (use the latter example if your class has studied these areas).
(1) Strongly disagree (2) Disagree (3) Undecided.
(3) Agree (5) Strongly agree

(N) 21. My friends like all other subjects better than arithmetic.
(1) Strongly disagree (2) Disagree (3) Undecided
(4) Agree (5) Strongly agree

(N) 22. I feel unsure of my answers in figuring.
(1) Strongly disagree (2) Disagree (3) Undecided
(4) Agree (5) Strongly agree

(P) 23. Most of my friends like to work arithmetic problems at the board.
(1) Strongly disagree (2) Disagree (3) Undecided
(4) Agree (5) Strongly agree

(N) 24. Sometimes I am embarrassed by, what seems to me, slowness in figuring.
(1) Strongly disagree (2) Disagree (3) Undecided
(4) Agree (5) Strongly agree

(N) 25. For some reason or other, many teachers are most impatient and cross during the arithmetic period.
(1) Strongly disagree (2) Disagree (3) Undecided
(4) Agree (5) Strongly agree

(P) 26. I like arithmetic better than <u>some</u> other subjects.
(1) Strongly disagree (2) Disagree (3) Undecided
(4) Agree (5) Strongly agree

(P) 27. Probably I have as much ability in arithmetic as in most other subjects.
(1) Strongly disagree (2) Disagree (3) Undecided
(4) Agree (5) Strongly agree

(P) 28. I consider arithmetic and solutions to arithmetic problems as much a personal challenge as playing some mental skill game such as scrabble, crossword puzzles, jigsaw puzzles, and the like.
(1) Strongly disagree (2) Disagree (3) Undecided
(4) Agree (5) Strongly agree

(N) 29. I can understand most parts of the arithmetic teachings, but fractions are difficult for me.

(1) Strongly disagree (2) Disagree (3) Undecided
(4) Agree (5) Strongly agree

(N) 30. Although arithmetic might be important to some occupations, there are other very fine occupations that require no arithmetic.

(1) Strongly disagre (2) Disagree (3) Undecided
(4) Agree (5) Strongly agree

APPENDIX B

INTERCORRELATION OF ITEMS

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | -.49 | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | .50 | -.50 | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | .50 | -.50 | .50 | | | | | | | | | | | | | | | | | | | | | | |
| 5 | .49 | .50 | .50 | .49 | | | | | | | | | | | | | | | | | | | | | |
| 6 | -.50 | .50 | -.50 | -.50 | .49 | | | | | | | | | | | | | | | | | | | | |
| 7 | .49 | -.50 | .49 | -.49 | .50 | .50 | | | | | | | | | | | | | | | | | | | |
| 8 | -.50 | .50 | -.48 | -.50 | .50 | .50 | .50 | | | | | | | | | | | | | | | | | | |
| 9 | -.50 | .50 | -.50 | -.50 | -.49 | .50 | .49 | .50 | | | | | | | | | | | | | | | | | |
| 10 | .50 | -.49 | .50 | .50 | .50 | -.49 | .50 | .49 | .49 | | | | | | | | | | | | | | | | |
| 11 | -.50 | .50 | -.50 | -.50 | -.49 | .50 | .50 | .50 | .50 | -.49 | | | | | | | | | | | | | | | |
| 12 | .50 | -.50 | .50 | .50 | .50 | -.50 | .50 | .50 | -.49 | .50 | -.50 | | | | | | | | | | | | | | |
| 13 | .50 | -.49 | .50 | .50 | .50 | -.50 | .50 | -.50 | -.50 | .50 | -.50 | .49 | | | | | | | | | | | | | |
| 14 | .50 | .50 | .50 | .50 | .50 | .50 | .50 | .49 | -.50 | .50 | -.49 | .50 | .50 | | | | | | | | | | | | |
| 15 | -.48 | 0.00 | .50 | .50 | .49 | -.49 | .50 | .50 | .50 | .50 | .50 | .50 | .49 | .50 | | | | | | | | | | | |
| 16 | -.50 | .49 | .49 | -.50 | -.49 | .50 | .50 | .50 | .50 | .49 | .50 | -.49 | .50 | .49 | .50 | | | | | | | | | | |
| 17 | .50 | -.49 | .50 | .50 | .49 | .49 | .50 | .49 | -.50 | .50 | -.50 | .50 | .50 | .50 | .50 | .50 | | | | | | | | | |
| 18 | -.49 | .49 | .49 | -.50 | -.49 | .50 | .50 | .50 | .50 | -.49 | .50 | -.50 | -.50 | .50 | .50 | .50 | -.49 | | | | | | | | |
| 19 | .50 | -.50 | .50 | .50 | -.50 | -.49 | .49 | -.50 | 0.00 | .50 | -.50 | .50 | .50 | .50 | .50 | .50 | .50 | -.50 | | | | | | | |
| 20 | .50 | .50 | .50 | .50 | .50 | -.49 | .48 | -.50 | -.50 | .50 | -.50 | .50 | .50 | .50 | .50 | .50 | .50 | .48 | .50 | | | | | | |
| 21 | -.50 | -.50 | .49 | -.50 | -.49 | .50 | -.50 | .50 | .50 | -.50 | .50 | -.50 | -.49 | -.49 | .49 | .50 | -.49 | .50 | .49 | .50 | | | | | |
| 22 | -.49 | .50 | .49 | -.50 | -.49 | .50 | .50 | .50 | .50 | -.50 | .50 | .49 | .50 | .50 | .49 | .50 | .50 | .50 | .50 | .50 | .50 | | | | |
| 23 | .50 | -.49 | .50 | .49 | .50 | .50 | .49 | .49 | .50 | .50 | .50 | .50 | .50 | .50 | .50 | .50 | .50 | .50 | .50 | .50 | .50 | .50 | | | |
| 24 | -.49 | -.48 | .49 | .50 | .49 | .50 | .50 | .50 | .50 | -.49 | .50 | -.50 | -.50 | .50 | .50 | .50 | -.49 | .50 | .49 | .49 | .50 | .50 | .50 | | |
| 25 | -.50 | .50 | -.50 | .50 | .50 | .50 | .49 | .50 | .50 | -.50 | .50 | -.50 | -.50 | .50 | .50 | .50 | -.49 | .50 | -.49 | -.50 | .50 | .50 | .50 | .50 | |

| | 26 | 27 | 28 | 29 | 30 |
|---|---|---|---|---|---|
| 27 | .50 | | | | |
| 28 | .50 | .50 | | | |
| 29 | -.49 | -.50 | .50 | | |
| 30 | .49 | .50 | .50 | .50 | |